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American Potato Journal

PUBLISHED BY
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SOMERVILLE, N. J. NEW BRUNSWICK, N. J.

NATIONAL POTATO WEEK

"The obvious purpose of National Potato Week, (recently celebrated) was to awaken consciousness on the part of consumers everywhere to the indispensable contribution of the white potato to our daily diet, and to combat the mistaken idea that the potato is more fattening than other common foods."

The week was conducted under the joint sponsorship of the National Potato Association and the Potato Association of America, in cooperation with numerous organizations interested in the potato industry. The State of Maine, through the Maine Development Commission and the State of Idaho, through the Idaho Fruit and Vegetable Advertising Commission, contributed to the effectiveness of National Potato Week by advertising the event in newspapers in more than one hundred of the leading consuming markets.

Potato Week was inaugurated by the following proclamation, issued by the Governors of nine of the leading potato states:

"Whereas . . . the white potato is admittedly 'Man's Greatest Food' since it contributed so generously in vitamins, calories, protein, and mineral salts to human health and growth, and

"Whereas . . . the white potato's invariable low-cost brings this royal vegetable to the poor table as well as to the rich board, and

"Whereas . . . the white potato represents one of America's greatest food crops, providing a livelihood to the farmer and an essential profit to the transportation companies and to thousands of food wholesalers and food retailers, be it

"Resolved . . . that the week of Friday, December 2d to Saturday, December 10th, 1938, shall be dedicated as National Potato Week so that those who grow, transport and distribute this healthful food will receive further evidence of its importance in their lives and so that those who enhance their diets through its consumption will win a greater appreciation of its leading role on the American table."

It is difficult to measure the returns from a campaign of this kind but it is certain to have value and should be continued. Potato growers everywhere should support this and other efforts to increase the consumption of their product.

INFLUENCE OF PHOTOPERIOD AND OTHER FACTORS ON THE FORMATION OF FLOWER PRIMORDIA IN THE POTATO

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Since the epoch making studies of Garner and Allard (2) a great body of literature on photoperiodism has been published but practically all of these studies have dealt with flowering and fruitfulness, comparatively few have been made to determine the influence of length-of-day and other conditions on the initiation of flower primordia.

A few experiments have been made with the potato and, as Stevenson and Clark (4) indicate, the use of supplementary light where the natural days are short, facilitates flower setting but it is not known from published reports whether the photoperiods found necessary for flowering and fruiting are also essential for the formation of flower primordia.

Werner (6) is of the opinion that the time of laying down of the flower primordia in the potato is genetically controlled and that when a rather definite number of nodes has been differentiated the flower initials are formed but the extent to which these develop depends upon the physiological conditions within the plant. The purpose of the experiment reported in the present paper was to determine not only the effects of various photoperiods but also the effects of temperature and size of seed pieces on the initiation of flower primordia with special emphasis on whether or not these primordia were formed under a wide range of conditions and if the inflorescences arose at different nodes in response to these various conditions.

Tubers of the Sebago potato grown on Aroostook Farm, Presque Isle, Maine, in 1937, shipped to Beltsville in October, and kept in common storage until the 1st of December, were used in the experiment. Comparisons were made between seed pieces of five different sizes; 5, 15, 25, 35 and 45 grams; two temperature conditions, 80°F. during the day, 55° at night, and 70° during the day and 45° at night; and four photoperiods, 9, 11, 13, and 16 hours of light. Each size of seed

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was planted in triplicate plots of four seed pieces each. Lights were turned on ten days after planting before any of the sprouts had broken through the surface of the soil. The supplementary light was supplied by 60 Watt Mazda lights suspended at a height of about 18 inches over the pots, and at intervals of 3 feet over the benches. The intensity of this artificial light ranged from 20 to 30 foot candles depending upon the location on the bench at approximately two inches above the pots. The growth of the plants was rather irregular because some of the tubers apparently had not completed the rest period. Figure 1 shows

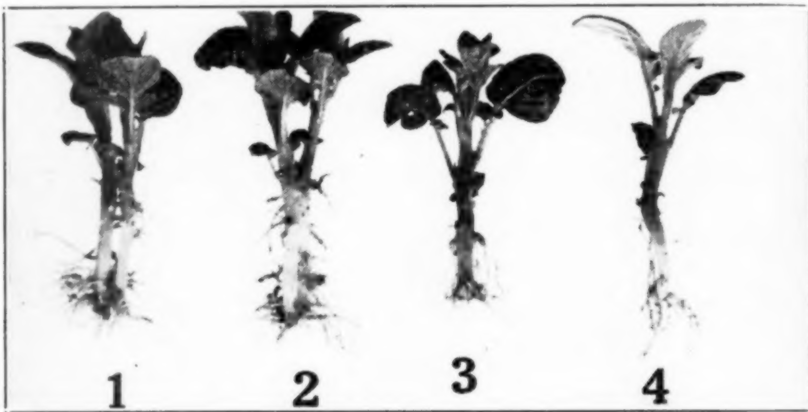

FIG. 1—Showing stage of development of potato plant at which flower primordia of the first cluster are differentiating. In each of the above plants 2 to 4 primordia have formed, Variety Sebago.

the approximate stage at which the plants were harvested and examined.

Approximately 240 plants were observed and the data for node number, at which the first inflorescence was formed, counting from the mother tuber, were analyzed. Variance caused by temperature, light and seed size exceeded the 1 per cent level of significance. First order interactions between these variables were below the 5 per cent level.

There was no significant difference in node number among plants from the four largest sizes of seed pieces (table 1). The 5-gram seed pieces, however, produced on the average an additional node before differentiating an inflorescence. The plants grown at the high temperature produced a mean of 1.21 more nodes on each plant than those at the low temperature before differentiating a flower cluster. There was no significant difference between the 11, 13, and 16-hour photoperiods. The plants at the 9-hour photoperiod, however, had a signifi-

TABLE 1. *Node at which first inflorescence formed on potato plants grown under different conditions of size of seed piece, temperature and photoperiod.*
Variety, Sebago

Size of Seed Piece			Temperature			Photoperiod		
Seed Weight (grams)	Number of Plants	Nodes to Flower Cluster (1)	°F.	Number of Plants	Nodes to Flower Cluster (2)	Hours	Number of Plants	Nodes to Flower Cluster (3)
5	96	22.84	80° day 55° night	240	22.54	9	120	22.28
15	96	21.64	70° day 45° night	240	21.33	11	120	21.95
25	96	21.63	—	—	—	13	120	21.75
35	96	21.80	—	—	—	16	120	21.76
45	96	21.77	—	—	—	—	—	—

1. 2x S. E. of a difference between means of 96 = 0.37 node.
2. 2x S. E. of a difference between means of 240 = 0.23 node.
3. 2x S. E. of a difference between means of 120 = 0.33 node.

cantly higher node number than the 13 or 16. The small size of seed piece, high temperature, and short photoperiod caused an increase in the number of nodes formed before the flower primordia were initiated. The extremes of variation, although highly significant, were not large. Flower primordia were produced under all conditions of the experiment.

As flower clusters were formed under all of the above conditions and even under the 9-hour photoperiod the question arose as to the minimum photoperiod for flower differentiation. An experiment was planned to test this point. The varieties used were Chippewa and Earlaine and the seed tubers were grown on Aroostook Farm, Presque Isle, Maine. They were shipped to Beltsville, Maryland, in October, 1937, and held in common storage until the 4th of April, 1938, at which time the seed pieces were cut, each weighing 5, 15, 25, 35, and 45 grams, respectively.

These were planted on the 11th of April in rich potting soil. Ten pieces of each size and variety were planted singly in 4-inch pots.

These were placed on small flat-cars mounted on steel tracks so they could be wheeled in and out of the dark house. The 10 pots having the same size seed piece of a variety were set in a row. All plants exposed to the same photoperiod were in the same car, which made a total of 100 pots or 10 rows for each car. The rows of pots in the different cars were randomized. Wet sawdust was packed about the pots; these were left in the dark house until the plants broke the soil surface, at which time differential light treatments of 0, 2, 4, 6 and 8 hours were begun. The 0 hour treatment was left in the dark house; all other lots were moved into the open each morning at 8 A. M. and left exposed for the required number of hours.

The plants were harvested on the 14th of May and examined under the dissecting microscope for flower primordia. The total number of primordia was determined for the largest shoot from each seed piece. Flower primordia on Chippewa plants were formed at all photoperiods including total darkness (table 2). In the latter plot the plants were

TABLE 2. *Total number of flower primordia per plot of* 10 *plants, variety, Chippewa.*

Size of Seed Piece	Photoperiod in Hours					Mean*	Primordia with Calyx Overlapping
	0	2	4	6	8		
	Number of Flower Primordia						
Grams 5	0	7	10	23	0	8.0	Per cent 65
15	16	32	58	36	49	38.2	63
25	34	52	62	50	54	50.4	73
35	35	83	27	48	64	51.4	74
45	38	93	85	61	53	66.0	82
*Mean	24.6	53.4	48.4	43.6	44.0	—	—

**S. E. of a difference between means of 5 plots = 18.75 flower primordia.

etiolated and several feet long. Primordia were formed on plants from all sizes of seed pieces, varying from 5 to 45 grams. Variance analysis of number of flower primordia formed gives a value for photoperiod below the 5 per cent level of significance. For size-of-seed-piece, however, the value exceeds the 1 per cent point. If twice the standard error of a difference is taken as the limits of experimental error, then 18.75 primordia are required for significance between means of 5 plots. Using this criterion, there is a significant difference in number of flower primordia between the plants from 5-gram seed pieces and those from all other sizes and between plants from 15 and 45-gram seed pieces.

In most of the plants the flowers of the first cluster were still differentiating. In some, formation of flower primordia had not yet begun. In order to get a measure of the difference in age of flower primordia in the different lots, all young buds that had the calyx overlapping were counted and the per cent of these is given in the last column of table 2. In general there was an increase in the percentage of older flowers with increase in size of seed piece, indicating that the plants from the larger size seed pieces reached the stage of flower differentiation a little sooner than the two smaller sizes. Circumstances beyond our control made it impossible to allow the plants to continue to grow until all the flowers of the first cluster had differentiated, and thus determine if the size of seed piece did actually influence the total

TABLE 3. *Total number of flower primordia per plot of* 10 *plants, variety Earlaine.*

Size of Seed Piece	Photoperiod in Hours					Mean	Primordia with Calyx Overlapping
	0	2	4	6	8		
	Number of Flower Primordia						
Grams							Per cent
25	46	18	19	15	22	24	77
35	52	56	—	42	56	51.5	78
45	23	81	91	91	66	70.4	86
Mean	40.3	51.7	55.0	49	48	——	—

number of flowers on each cluster. The data in table 2 are merely a comparison of the number of flowers differentiated on plants of a certain age.

The results secured with Earlaine (table 3) were similar to those secured with Chippewa (table 2). There was considerable decay in the seed pieces of Earlaine of the two smaller sizes and therefore the data for these are not included.

It is interesting to note that flower primordia were differentiated in complete darkness. This phenomenon has been reported for very few plants so far as known and chiefly those plants that have a reserve of food upon which to draw. Mulder and Luyten (3) showed that flower primordia were differentiated in tulip bulbs in storage, and Blaauw (1) showed the same thing for *Hyacinthus orientalis*. Thompson and Smith (5) also observed differentiation of the floral axes in onion bulbs that were stored in the dark.

Summary

The first inflorescence of the potato was differentiated at approximately the same node under a range of conditions including size of seed piece, temperature and photoperiod. The small size of seed piece (5 grams), both the high temperature (80° during the day, and 55° night), and the short photoperiod (9 hours) had a tendency to increase the node number to the first inflorescence.

Flower primordia were differentiated in total darkness.

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THE INTERACTION OF BORDEAUX MIXTURE SPRAY, SULFUR AND PYRETHRUM DUSTS ON POTATO YIELDS AND INSECT CONTROL

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In tests previously reported, increased yields of potatoes were obtained in certain experiments in Western New York by increasing the amounts of copper sulfate applied in the form of bordeaux mixture. Maximum yields were obtained by applications of approximately 75 pounds of copper sulfate to the acre during the season. The use of larger amounts of copper sulfate increased foliage growth at the expense of tuber formation. Furthermore, these experiments showed that the application of the larger portion of this optimum amount of 75 pounds in the early part of the season not only gave still greater increases in tuber weights but also a better grade of tubers, as compared with applications of equal amounts of copper to each application or larger amounts in the latter part of the growing season (2).

These investigations suggested that the increased yields from bordeaux mixture were not due entirely to its fungicidal and insecticidal properties. In following up this suggestion, experiments were conducted in 1935 and 1936 to determine the comparative effects of applications of bordeaux mixture with and without the application of insecticides designed to control the insects independently of the bordeaux mixture. A summary from all these experiments gives some indication of the effects of these insecticidal dusts both on yields and insect control.

METHODS OF EXPERIMENTAL PROCEDURE

Bordeaux mixture was applied with a power sprayer, using four hundred pounds pressure and three nozzles to the row. Sprayed and unsprayed plots were replicated four times in accordance with a modification of the "half-drill-strip" method (3). Two types of experiments were conducted. In the first, the total amount of copper sulfate applied during the season as bordeaux mixture varied from

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[2]Department of Entomology.
[3]Department of Entomology.

24 to 144 pounds to the acre during the season. This type of experiment will be referred to as the "concentration experiment." In the second type, referred to as the "seasonal distribution experiment" three different schedules were used as given below:

APPLICATION SCHEDULES

Application	High to Low	Low to High	Equal
1st	5-2½-50	2-1-50	5-2½-50
2nd	10-5-50	2-1-50	5-2½-50
3rd	8-4-50	4-2-50	5-2½-50
4th	6-5-50	6-3-50	5-2½-50
5th	4-2-50	8-4-50	5-2½-50
6th	2-1-50	10-5-50	5-2½-50
7th	2-1-50	5-2½-50	5-2½-50
Total amounts of copper sulfate to the acre for 1935	74 pounds	74 pounds	70 pounds
ADDITIONAL APPLICATIONS FOR 1936			
8th	2-1-50	6-3-50	5-2½-50
9th	2-1-50	6-3-50	5-2½-50
Total amounts of copper sulfate to the acre for 1936	82 pounds	98 pounds	90 pounds

In addition to the bordeaux two materials, (1) 325 mesh dusting sulfur and (2) a mixture of 25 pounds of pyrethrum[1] and 75 pounds of Celite,[2] were applied with a hand duster in 56 foot strips across two replicates of the sprayed and unsprayed plots. Dusting sulfur was cross-dusted only in the 1935 seasonal distribution experiment and pyrethrum dust was used on the concentration experiment. Sulfur and pyrethrum were dusted on separate, although adjoining blocks, in each of the 1936 experiments.

The number of tip-burned leaflets was recorded at intervals from ten plants of each treatment. A leaflet was considered tip-burned when more than one-eighth of its leaf surface was dead, no distinction being made between tip burning caused by insects or physiological causes.

Collections of all insects from plants of various treated plots were made. These were made by carefully placing a piece of oil cloth under a plant which was then bent into a horizontal position so

[1]Pyrethrum dust "Powco Activated A" procured from the John Powell Company.

[2]Celite, a diatomaceous earth procured from the Johns Manville Company.

that the cloth could be quickly wrapped around it. After vigorously shaking the plant to remove the insects, the contents of the bag were emptied into cyanide bottles and later stored in alcohol for counting. With great care in the operation few insects escaped or remained on the plant, although the small instars of leafhopper nymphs and aphids were difficult to remove even with drastic shaking. Nymphal instar counts of the potato leafhopper were taken a number of times during the season from sprayed and unsprayed plots.

There was no late blight during the two seasons in which these experiments were conducted. Insects occurring in large numbers were the potato flea beetles, leafhoppers, tarnished plant bugs, and aphids.

TABLE I.—*A comparison of the insect populations from treatments in concentration experiment,* 1935

Pounds Copper Sulphate to the Acre as Bordeaux Mixture	Potato Leafhopper Nymphs	Potato Leafhopper Adults	Flea Beetles	Tarnished Plant Bug Nymphs	Tarnished Plant Bug Adults	Aphids
Without Pyrethrum Dust						
0	36.1	16.9	212.4	22.9	5.2	94.1
24	13.3	5.5	119.6	22.4	5.9	120.7
36	6.9	4.6	61.8	14.0	7.4	130.1
48	1.2	.8	24.7	11.0	6.8	187.8
73	1.1	1.1	27.1	16.2	5.8	173.4
96	.4	.6	16.7	7.0	2.8	237.3
144	.4	.8	17.4	13.6	4.3	180.7
With Pyrethrum Dust						
0	0	.4	106.0	4.2	1.8	198.2
48	0	.2	7.2	3.4	.8	114.0
144	.2	.6	10.2	5.0	3.0	316.0

24 to 144 pounds to the acre during the season. This type of experiment will be referred to as the "concentration experiment." In the second type, referred to as the "seasonal distribution experiment" three different schedules were used as given below:

APPLICATION SCHEDULES

Application	High to Low	Low to High	Equal
1st	5-2½-50	2-1-50	5-2½-50
2nd	10-5-50	2-1-50	5-2½-50
3rd	8-4-50	4-2-50	5-2½-50
4th	6-5-50	6-3-50	5-2½-50
5th	4-2-50	8-4-50	5-2½-50
6th	2-1-50	10-5-50	5-2½-50
7th	2-1-50	5-2½-50	5-2½-50
	Total amounts of copper sulfate to the acre for 1935		
	74 pounds	74 pounds	70 pounds
	ADDITIONAL APPLICATIONS FOR 1936		
8th	2-1-50	6-3-50	5-2½-50
9th	2-1-50	6-3-50	5-2½-50
	Total amounts of copper sulfate to the acre for 1936		
	82 pounds	98 pounds	90 pounds

In addition to the bordeaux two materials, (1) 325 mesh dusting sulfur and (2) a mixture of 25 pounds of pyrethrum[1] and 75 pounds of Celite,[2] were applied with a hand duster in 56 foot strips across two replicates of the sprayed and unsprayed plots. Dusting sulfur was cross-dusted only in the 1935 seasonal distribution experiment and pyrethrum dust was used on the concentration experiment. Sulfur and pyrethrum were dusted on separate, although adjoining blocks, in each of the 1936 experiments.

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Without Pyrethrum Dust						
0	36.1	16.9	212.4	22.9	5.2	94.1
24	13.3	5.5	119.6	22.4	5.9	120.7
36	6.9	4.6	61.8	14.0	7.4	130.1
48	1.2	.8	24.7	11.0	6.8	187.8
73	1.1	1.1	27.1	16.2	5.8	173.4
96	.4	.6	16.7	7.0	2.8	237.3
144	.4	.8	17.4	13.6	4.3	180.7
With Pyrethrum Dust						
0	0	.4	106.0	4.2	1.8	198.2
48	0	.2	7.2	3.4	.8	114.0
144	.2	.6	10.2	5.0	3.0	316.0

TABLE 2.—*A comparison of the insect population from treatments in concentration experiment,* 1936

Pounds Copper Sulphate to the Acre Applied as Bordeaux	Potato Leafhoppers Nymphs	Potato Leafhoppers Adults	Flea Beetles	Tarnished Plant Bug Nymphs	Tarnished Plant Bug Adults	Aphids
Without Dust						
0	12.1	13.1	4.7	3.9	1.0	56.4
20	6.5	5.4	.8	3.3	.6	92.9
30	7.2	5.4	.7	2.9	.7	103.6
40	2.9	3.9	.5	1.9	.5	109.0
60	2.6	2.0	.8	3.5	.4	90.9
80	1.5	2.5	.6	2.3	.4	112.9
120	.7	1.3	.4	2.7	.5	102.2
With Pyrethrum Dust						
0	1.6	1.3	.3	2.3	.1	180.1
20	.1	.4	.2	1.0	0	156.1
60	.1	.3	.1	.8	0	183.9
120	.1	.1	.1	1.6	0	98.9
With Sulfur Dust						
0	.1	.9	1.3	1.1	.3	323.2
20	.5	.8	.2	.7	.2	91.0
60	0	.3	.6	.8	.3	169.5
120	.2	.5	.5	1.6	.1	205.4

Effect of Treatment on Insect Control and Tip-burned Leaflets on Each Plant

For the 1935 experiment insect populations were obtained on the 10th of September from ten plants in two replicates of each concentration in the undusted block. Marked decreases were found in flea beetle and leafhopper populations with increasing amounts of copper sulfate up to 48 pounds to the acre, as recorded in table 1. More than this amount of the material gave only slightly better control of these insects. Small and insignificant reductions in the tarnished plant bug population were obtained from the bordeaux mixture sprayed plots, whereas aphid populations were materially increased. Pyrethrum dust decreased the numbers of insects, with the exception of the aphids, in comparison with those found in corresponding plots of the undusted block.

In the 1936 concentration experiment insect population counts were taken at intervals from three adjoining blocks, two of which were dusted with either sulfur or pyrethrum superimposed on the spray concentrations. The data in table 2 are averages of three collections taken during the growing period. In general the insect population was low throughout the experiment, hence no great differences were obtained among the plots receiving varying amounts of copper sulfate applied in the form of bordeaux mixture. As in 1935, bordeaux mixture spray reduced the flea beetles and leafhopper populations but increased the number of aphids over the non-sprayed. Applications of either sulfur or pyrethrum dusts decreased the number of flea beetles, leafhoppers and tarnished plant bugs under those in corresponding plots of the non-dusted block, but increased the aphid population.

Counts of tip-burned leaflets taken in the 1935 concentration experiment and summarized in table 3 show that tipburn became noticeable by the 17th of August and increased gradually as the growing season advanced until the middle of September when a sharp rise in the number was recorded. All concentrations of bordeaux mixture reduced the injury under the non-sprayed but no marked differences are evident among treatments. Counts taken in the pyrethrum-dusted block were similar to those from corresponding plots of the non-dusted block. Since the pyrethrum dust reduced the leafhopper populations by 99 per cent it is evident that leafhoppers were not entirely responsible for tipburn injury. Tipburn, as recorded, was undoubtedly a composite of all insect injuries and physiological maturity of the plant.

TABLE 3.—*Average number of tipburned leaflets on each plant from treatments in concentration experiment,* 1935

Date of Counts	Total Amount of Copper Sulfate Applied on Each Acre During the Season as Bordeaux Mixture						
	0	24	36	48	73	96	144
	Without Pyrethrum Dust						
Aug. 17	11.0	4.6	5.5	3.4	4.0	2.9	2.8
Aug. 30	63.9	19.5	16.3	9.3	13.3	10.4	10.4
Sept. 11	129.0	60.5	51.8	47.3	45.9	48.9	55.0
Sept. 23	199.5	195.4	210.1	208.9	222.9	230.9	261.9
	With Pyrethrum Dust						
Aug. 17	10.1	5.9	4.2	3.4	4.4	2.5	3.0
Aug. 30	56.7	15.4	14.2	12.1	12.5	11.4	12.9
Sept. 11	139.1	65.2	51.4	44.8	50.7	53.7	48.0
Sept. 23	239.5	221.0	227.9	245.4	262.9	289.1	265.2

All figures averages of 10 plants.

TABLE 4.—*A comparison of insect populations to the plant from treatments in seasonal distribution experiment,* 1935

Schedule Used	Potato Leafhoppers Nymphs	Potato Leafhoppers Adults	Flea Beetles	Tarnished Plant Bug Nymphs	Tarnished Plant Bug Adults	Aphids
	Without Sulfur Dust					
Non-sprayed	17.0	13.0	203.5	23.1	5.1	101.9
High to Low	1.4	1.3	28.9	6.4	3.5	304.2
Low to High	2.8	2.6	22.3	9.2	4.2	241.8
Equal	2.8	1.9	29.1	8.1	3.5	202.9
	With Sulfur Dust					
Non-sprayed	1.5	1.2	178.0	7.5	6.0	515.0
High to Low	.7	1.0	26.7	4.1	3.1	521.3
Low to High	.3	.6	33.2	3.1	3.3	811.3
Equal	.4	.8	40.9	2.3	3.6	544.0

Approximately equal control of leafhoppers, flea beetles, and tarnished plant bugs was obtained in the 1935 seasonal distribution experiment, regardless of the application schedule used. This schedule is given in table 4.

The application of sulfur dust on sprayed and non-sprayed plants in an adjoining block reduced leafhopper and tarnished plant bug populations on non-sprayed plots comparable to populations obtained from the bordeaux plots. The dust, however, had little or no effect on the control of the flea beetle. Aphids were increased more by sulfur dust than by bordeaux mixture spray.

Similar results were obtained from the 1936 seasonal distribution experiment. Four insect collections were taken during the season beginning the 22d of July and including the 21st of September,

TABLE 5.—*Comparison of the insect population to the plant from treatments in the seasonal distribution experiment,* 1936

Spraying Schedule Used	Potato Leafhopper Nymphs	Potato Leafhopper Adults	Flea-Beetles	Tarnished Plant Bug Nymphs	Tarnished Plant Bug Adults	Aphids
Without Dust						
Non-sprayed	10.0	9.9	17.1	1.6	1.9	250.9
High to Low	1.0	2.2	6.8	.9	.7	318.5
Low to High	.5	1.4	4.7	.5	.7	392.9
Equal	.2	1.6	4.9	.7	.7	257.7
With Pyrethrum Dust						
Non-sprayed	.8	1.2	5.3	.9	.7	375.3
High to Low	.2	.8	2.9	1.1	.7	485.2
Low to High	.1	.7	3.1	.6	.4	839.7
Equal	.1	.6	3.6	.5	.6	700.5
With Sulfur Dust						
Non-sprayed	.1	.9	12.9	.5	.7	842.2
High to Low	.2	1.0	4.9	.5	.7	744.2
Low to High	.1	.9	4.1	.4	.6	644.1
Equal	0	.7	2.6	.5	.7	528.5

previous to killing frost. The collections, averaged and summarized in table 5, were somewhat lower than those of the previous year, particularly the populations of flea beetles and tarnished plant bugs. Leafhoppers, flea beetles and tarnished plant bugs were reduced by bordeaux mixture sprays but without any apparent differences among schedules. Increases in the numbers of aphids were obtained with the bordeaux mixture sprays similar to those in the 1935 experiment. Pyrethrum dust on the adjoining non-sprayed plots reduced leafhoppers, flea beetles, and tarnished plant bugs equal to reductions obtained by bordeaux mixture. Similarly, sulfur dust reduced leafhoppers and tarnished plant bugs but gave only slight control of flea beetles. As in the above-mentioned results, the aphid population was increased more by the dusts than by bordeaux mixture. Oddly enough, when sulfur was applied in addition to bordeaux, there was no increase in the aphid population compared with the sulfur alone. The

TABLE 6.—*Average number of tipburned leaflets to the plant from treatments in seasonal distribution experiments,* 1935 *and* 1936

Date of Counts	Non-sprayed	High to Low	Low to High	Equal	Non-sprayed	High to Low	Low to High	Equal
	Without Sulfur Dust				With Sulfur Dust			
				1935				
8/16	9.4	1.8	2.3	2.7	10.4	2.0	2.6	2.3
8/27	82.0	18.2	27.7	26.1	58.4	18.7	21.0	22.9
9/10	222.4	52.6	46.4	48.8	206.4	50.6	45.0	47.3
9/21	329.6	236.0	189.2	202.8	325.2	214.2	142.8	191.3
				1936				
8/11	2.3	.3	0	.7				
8/18	17.0	4.5	3.8	1.8				
8/24	22.7	3.9	3.8	2.8				
9/3	48.7	11.9	4.6	1.5				
9/17	175.6	51.8	24.6	19.8				
9/29	300.4	160.8	69.6	53.4				

All figures averages of 10 plants.

tendency to increase the aphid population by the application of bordeaux mixture has been observed by other investigators (5, 6).

Tipburn was recorded at intervals during the 1935 season from dusted and non-dusted blocks and from the non-dusted block in 1936. In both years tipburn increased more rapidly on the non-sprayed than on the sprayed plants as shown in table 6. Although a 96 per cent control of leafhopper nymphs was obtained on the non-sprayed sulfur-dusted plots, tipburn was as severe, and the plants died down at the same time as the controls.

The greater number of tip-burned leaflets late in the season in the high to low treatments is probably due to earlier maturity of the plants in this treatment.

Further evidence that tipburn as recorded in this paper was not caused primarily by injury by leafhopper nymphs was obtained from instar counts taken in 1936 as recorded in table 7. It will be noted

TABLE 7.—*Instar counts of potato leafhopper nymphs in seasonal distribution experiment,* 1936

Treatment and Schedule	Nymphal Instars					Total Number Nymphs on Ten Plants
	First	Second	Third	Fourth	Fifth	
Non-sprayed	28.5	171	132	161	160.5	653
Bordeaux spray High to Low	15.5	47.5	10	3	0	76
Bordeaux spray Low to High	25.5	77.5	29.5	4	2.5	139
Bordeaux spray Equal	37	81	13.5	4.5	2	138
Pyrethrum dust	10	12	1	0	0	23
Sulfur dust	14	11	2	0	0	27

that from the nymphs recorded on the sprayed plants a very low percentage was found in the third to fifth instars. According to Fenton and Hartzell (1) nymphs of these instars produced more hopper burn than early instar nymphs.

EFFECT OF TREATMENTS ON YIELDS

In order to determine the effect of bordeaux mixture, sulfur and pyrethrum dust on tuber weights, only the final weights of compara-

tive plots from a number of experiments were averaged together. In the bordeaux mixture spray series only those blocks receiving more than 75 pounds and less than 128 pounds of copper sulfate to the acre during the season were used in these comparisons regardless of the type of application made. These blocks, then, were compared with the non-sprayed, sulfur and pyrethrum dusted and the combination of either sulfur or pyrethrum dusted in addition to the bordeaux mixture sprayed.

It is believed that by using those blocks receiving the above mentioned amount of copper sulfate, an amount which is recommended and has been proven most economical in the section of the state where these experiments were conducted, a fair comparison could be made between bordeaux mixture spray, sulfur and pyrethrum dust.

In the series in which bordeaux mixture spray and sulfur dust were compared, bordeaux mixture spray gave a significant increase in yields over the non-sprayed and the sulfur dusted blocks as shown

TABLE 8.—*Final tuber yields of* 40 *plants from comparable blocks of the various Bordeaux spray and sulfur dust experiments,* 1935-1936

Blocks	Pounds of Copper Sulfate	Non-sprayed and Non-dusted	Sulfur Dust Alone	Bordeaux Spray Alone	Bordeaux Spray and Sulfur Dust
Tuber Weights in Pounds					
1	76	32.1	32.4	36.4	34.1
2	76	29.8	30.6	38.4	38.1
3	74	34.5	32.7	55.7	50.8
4	83	56.6	59.3	81.7	71.3
5	128	26.4	24.6	41.7	38.5
6	128	37.0	36.6	44.4	40.3
7	128	31.0	32.6	38.0	37.4
Average		35.3	35.5	48.0	44.4
Average yields in bushels to the acre (Assuming 16,000 plants to the acre)					
		235.6	237.0	319.9	295.7

Necessary for a significant difference 31.3 bu. to the acre.

in table 8. Sulfur dust alone gave practically the same yields as the non-sprayed, and the sulfur used in addition to the bordeaux mixture spray gave yields lower than the bordeaux mixture spray alone.

In the bordeaux mixture-pyrethrum series, pyrethrum dust increased the yields 45.6 bushels compared with the non-sprayed, an increase which is highly significant. Bordeaux mixture spray gave a significant increase in yields over the non-sprayed and also a substantial increase over the pyrethrum dust which proved to be significant. Applying pyrethrum dust in addition to bordeaux mixture spray had an additive effect on the increase in yields, but the additional increase in bushels compared with the bordeaux spray alone did not prove to be significant.

TABLE 9.—*Final tuber yields of* 40 *plants from comparable blocks of the various Bordeaux spray and Pyrethrum dust experiments,* 1935-1936

Blocks	Pounds of Copper Sulfate	Non-sprayed and Non-dusted	Pyrethrum Dust Alone	Bordeaux Spray Alone	Bordeaux Spray and Pyrethrum Dust
		Tuber Weights in Pounds			
1	76	29.8	30.8	34.4	35.9
2	76	29.5	36.5	40.1	41.9
3	76	29.5	43.6	53.8	54.8
4	73	22.7	29.0	43.9	51.8
5	83	56.7	67.1	81.7	77.8
6	128	35.1	37.5	39.0	41.4
7	128	29.9	34.4	39.3	39.6
8	128	24.8	35.6	34.8	36.4
9	144	22.7	29.0	42.7	46.9
Average		31.2	38.2	45.5	47.4
		Average yields in bushels to the acre (Assuming 16,000 plants on each acre)			
		207.9	254.4	303.5	315.9

Necessary for a significant difference 30.3 bu. to the acre.

Summary

With increasing amounts of copper sulfate applied the population of the potato leafhopper (nymphs and adults) decreased, a 96-98 per cent control of the nymphs being obtained when more than 48 pounds of copper sulfate were used.

Applying an equal amount of copper sulfate at different schedules throughout the season, showed only slight differences in the control of potato leafhoppers.

A lower percentage of leafhopper nymphs belonging to the fourth and fifth instars was found on sprayed plants than on non-sprayed.

Applications of sulfur and pyrethrum dusts gave an additive control of potato leafhoppers when less than 48 pounds of copper sulfate were used, and if used alone gave control similar to that of bordeaux mixture.

With increasing amounts of copper sulfate up to 48 pounds to the acre, the population of flea beetles decreased, giving only slightly better control when additional copper sulfate was used. Pyrethrum dust reduced this pest to approximately the same extent as 36 pounds of copper sulfate. There was only a slight reduction of this pest with sulfur dust.

There was a decrease in the number of tarnished plant bugs with bordeaux mixture, sulfur, or pyrethrum.

Applications of bordeaux mixture, sulfur and pyrethrum increased the aphid population on the plants.

The tip-burned leaflet counts, as recorded, are undoubtedly a composite of insect injury and maturity of the plants.

A summary of the results from a number of experiments shows the best yield increases with bordeaux mixture, and next best with pyrethrum dust. Sulfur dust had no apparent effect on increasing yields. Pyrethrum dust used in addition to bordeaux mixture gave increased yields when compared with bordeaux mixture used alone, but they were so small as to be of doubtful significance.

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THE GROWTH OF ACTINOMYCETES ON DIFFERENT VARIETIES OF POTATOES[1]

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Fluegge (1) was the first to express the opinion that the type of growth of bacteria on potato may depend largely upon the nature of the latter. In recent years, Burgwitz and Vladimirskaia (2) made a detailed study of the growth of various soil bacteria of plant pathogens and of different actinomycetes on pure varieties of potato. Marked differences were obtained in the growth of certain species of bacteria and the Actinomyces used. The possibility was suggested that the resistance of potatoes to parasitic infection may be determined by growth tests of this type.

In order to determine the possible relation of the "immunity" of certain varieties of potato to infection by actinomycetes and the ability of these organisms to grow upon these varieties of potato in culture, several investigations were undertaken.

An attempt was made first, to correlate the growth of actinomycetes upon potato with sensitivity or resistance of the variety to scabbing, since if this were true, it might lead to an allocation of factors in the composition of the tuber which is related to resistance or susceptibility; secondly, to determine whether the variation obtained actually resulted from differences in the tuber or whether other factors were responsible. And finally, since the character of growth on potato slants plays a prominent part in the identification of given species of actinomycetes an alteration in this character dependent upon the variety of potato used would be of considerable interest for purposes of identification.

The method used by previous investigators consisted in placing a plug from the central portion of the potato in a test tube, sterilizing at 15 pounds pressure for 15 minutes, inoculating with the particular

[1]Journal Series Paper, Department of Soil Microbiology.

Actinomyces and observing the amount and type of growth at the end of one week's incubation at 28°. Such a method is subject to a considerable amount of personal variation depending upon the judgment of the observer, and naturally will destroy any heat labile factors that may be involved, but it has been claimed (2) that even with these limitations distinct and definite differences could be noted.

Except where otherwise indicated the same method was followed in the studies reported here, in a serious attempt to duplicate the conditions of earlier workers.

The first experiment was conducted with potatoes which had been in cold storage for approximately four months. The varieties of potatoes employed were as follows:

1. Green Mountain	5. Golden
2. Cobbler	6. Kittany Cobbler
3. Warba	7. S 45986
4. Houma	8. S 44515

Each of these varieties was inoculated with the following strains of actinomycetes taken from the culture collection of the New Jersey Agricultural Experiment Station.

3328	*Actinomyces halstedii*
3385	Unidentified
3382	Non acid-fast proactinomyces
3326a	*Actinomyces griseus*
3356	*Actinomyces viridochromogenus*
3322a	*Actinomyces fradii*
3355	*Actinomyces violaceus-ruber*
3018	*Actinomyces scabies* (Morse strain)

None of the scab forming strains used in these studies was tested for present pathogenicity.

The data for two experiments using these combinations is presented in table 1. Observations were recorded at the end of one and again after three weeks. It is apparent that after one week considerable variation is evident whereas after three weeks this variation has largely disappeared. We may consider for simplicity only one case in detail; that of *Actinomyces halstedii* which is entirely typical of the results obtained, as is apparent by a close study of table 1. The results for this strain are given graphically in figure 1. They show that at the end of one week considerable variation is present among the different varieties of potato. At the end of three weeks, however, growth on all potato varieties was very similar. In the second experiment, although

considerable variation in growth is again observed during the early stages, the variations show no correlation with the variety of potato. In experiment 1 the Cobbler and Green Mountain varieties showed virtually no growth at the end of a week, whereas in experiment 2 these

TABLE 1

		One Week								Three Weeks							
	Experiment	Green Mountain	Cobbler	Warba	Houma	Golden	K. Cobbler	S 45986	S 44515	Green Mountain	Cobbler	Warba	Houma	Golden	K. Cobbler	S 45986	S 44515
Actinomyces halstedii	I	0	0	2	2	2	1	1	4	4	4	4	4	4	4	4	4
	II	3	4	0	1	0	3	1	3	4	4	4	4	4	4	4	4
Actinomyces viridochromogenus	I	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Actinomyces griseus	I	3	1	1	4	4	0	2	3	4	3	4	4	4	0	4	4
	II	3	4	0	0	4	0	2	0	4	4	4	4	4	1	3	4
Actinomyces fradii	I	2	2	1	3	4	2	4	3	4	4	4	4	4	4	4	4
	I	4	4	3	2	3	0	2	2	4	4	4	4	4	4	4	4
Actinomyces violace-us-ruber	I	3	0	2	4	2	2	3	4	4	3	4	4	4	4	4	4
	II	4	4	1	2	3	2	4	3	4	4	4	4	4	4	4	4
Actinomyces scabies	I	4	2	0	0	1	0	3	2	4	4	4	4	4	4	4	4
Proactinomyces non-acid fast	I	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	1
Thermophile A at 50° unidentified	I	4	4	4	0	3	4	4	1	4	4	4	4	4	4	4	4
	II	4	4	4	3	4	4	4	0	4	4	4	4	4	4	4	4

0..........No growth
1..........Faint growth
2..........Fair growth
3..........Good growth
4..........Very good growth

same two varieties showed an abundant growth. The variation of the strains on all varieties of potatoes used in these two experiments may be characterized by the following: (1) the variations observable at the end of a week's interval tend to become less as the cultures become older

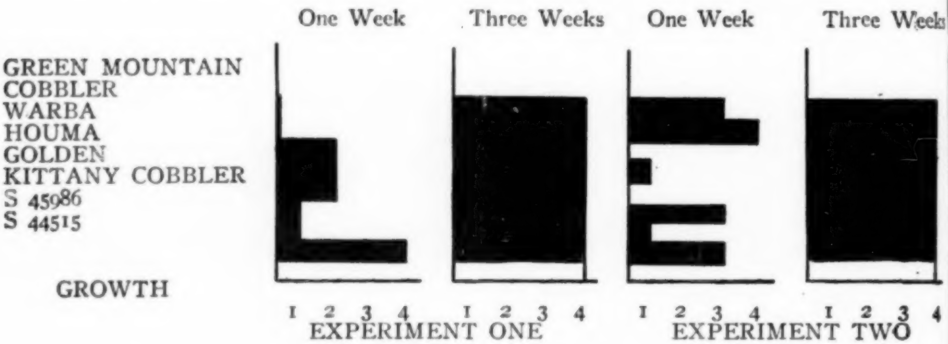

FIG. 1. Growth of *Actinomyces halstedii* on different potato varieties (Potatoes stored three months)

so that by the end of three weeks few, if any, differences were apparent; (2) the variations observable at the end of one week were not reproducible. Variations in growth were not correlated with the variety of potato but are caused by some other factor.

Since it is difficult to obtain uniform inocula when working with actinomycetes it was thought that probably the non-uniformity of the inoculum, rather than inherent differences in the potato variety, might be the cause of the differences in growth. Support was given to this view since variations tended to disappear as the culture aged and since large slices in flasks inoculated with 1 cc. of a fairly uniform suspension of Actinomyces mycelium showed much less variation than the tubed cultures. An experiment with *Actinomyces fradii* and *Actinomyces halstedii* using five replicates of each potato variety showed as much variation among tubes containing the same potato as among different varieties of potato.

These two experiments, showing that the reported variation was due to causes other than the variety of potato employed, were not entirely valid since the potatoes used had been subjected to a considerable period of storage and this factor might influence the results. It was also possible that the proper strain of Actinomyces had not been found. Another experiment, employing nine varieties of freshly dug potatoes and sixteen species of actinomycetes was conducted. The actinomycetes chosen included six distinct varieties of *Actinomyces*

scabies, three thermophilic forms and at least one each of the major groups of actinomycetes and proactinomycetes. The following potato varieties were used:

1. Green Mountain
2. Cobbler
3. Mesaba
4. Warba
5. Chippewa
6. Katahdin
7. White Rose
8. Sebago
9. Erlaine

The following strains of actinomycetes were employed:

Actinomyces scabies		*Other actinomycetes*	
3031	Shapovalov (20)	3385	Unidentified strain
3023	Morse (0261)	3326a	*Actinomyces griseus*
3032	Shapovalov (25)	3328	*Actinomyces halstedii*
3035	Florida-Brown Co. Strain	3043	Unidentified strain
3021	Morse Strain (I. E. 259)	568A	Acid-fast proactinomyces from scab
3018	Morse Strain (1921)	114R	Proactinomyces
3352	Thaxter Strain	3008Z	*Actinomyces hominis*

Thermophiles

3389	White form
3390	Black form
MM	*Micromonospora vulgaris*

In addition, a series of tubes was prepared by autoclaving the potato slant under water and removing the water just before inoculation. This leaves the potato slice in a slightly better condition, but no difference could be noted in growths on these slants compared with growth on the other type. The complete data are given in table 2. In this case duplicate slants of each combination were prepared. In those cases where the duplicates agreed only the single figure is given, whereas where disagreement between duplicates was noted the results for each are recorded. By simply noting those spaces in the table which contain two figures a fair idea of the agreement among duplicates can be obtained.

TABLE 2

	One Week									Three Weeks								
	Green Mountain	Cobbler	Mesaba	Warba	Chippewa	Katahdin	White Rose	Sebago	Erlaine	Green Mountain	Cobbler	Mesaba	Warba	Chippewa	Katahdin	White Rose	Sebago	Erlaine
Actinomyces scabies 3031	4	4	4	4	4	4	1–4	4	4	4	4	4	4	4	3–4	3	4	4
Actinomyces scabies 3023	3–2	0–2	3	3	3	0–3	0–2	3	2–3	3	1–4	3–4	3	4	1–4	2–3	4	3–4
Actinomyces scabies 3032	4	0–1	4	4	3–4	2–4	0–1	3–4	2–3	4	4	3–4	3–4	4	4	3	3–4	3
Actinomyces scabies 3035	2	2	3	2–3	4	2	1–2	4	2–3	3–4	3–4	3	3	4	4	3	4	3
Actinomyces scabies 3021	4	4	4	4	3–4	3–4	3	3–4	3–4	4	4	3	3–4	4	4	2	4	3
Actinomyces scabies 3018	2	3	2	3	3–4	3	1–2	3–4	3	4	4	3	3	4	3	3	4	3
Actinomyces scabies 3352	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4
Thermophile A	2	0–1	0–2	0	0–1	0	0–1	0	0–1	4	2–3	3	3–4	2	2–4	2	3	3
Thermophile B	1–2	1	0–1	1–2	1–2	0–2	0–1	0–1	2	4	4	4	4	4	4	4	4	4
Micromonospora vulgaris	0	0	0	0	0	0	0	0	0	2	2–3	2	2	2–3	2	2	2	2
Actinomyces griseus	3–4	3	3	3–4	3	3	3	3	3	4	4	4	4	4	4	3–4	3	4
Actinomyces halstedii	4	2	3–4	4	4	3	3–4	3–4	2–3	4	4	4	4	4	4	4	4	4
Actinomyces hominis	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Proact. acid fast	0–1	2	0–1	2–3	1–2	0–1	1	2	0	2	3	1–2	2	1–2	1–2	2	1–2	1
Proact. non acid fast	0	0	0	0	0	0	0	0	0	4	4	4	3	4	4	4	4	4
Unidentified (3385)	1	1	1	0–1	0–1	0	0	0–1	0	3–4	3–4	3	4	4	3	2–4	3	3
Unidentified (3043)	3	2–3	3	3	3	2–3	1–2	3	3	3–4	4	3–4	4	4	3	2–3	3–4	3

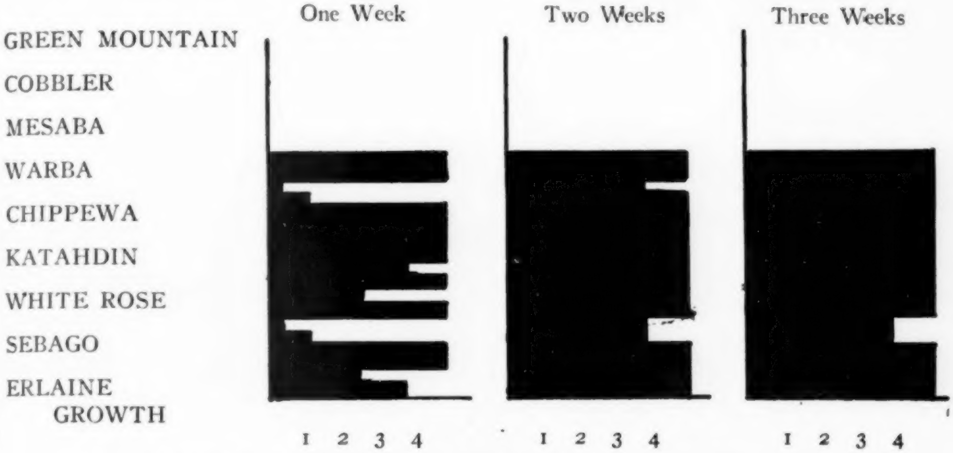

FIG. 2. Growth of *Actinomyces scabies* (3031) on different potato varieties (Freshly dug potatoes)

One of the *Actinomyces scabies* strains (3031) affords a typical example which may be used for more detailed consideration. Data for this organism are given in figure 2. It is apparent from the data that differences between duplicates were as great as those between varieties of potatoes. No correlation whatsoever is observable between resistant or susceptible varieties and actinomycete growth on the slant. These observations were checked by two independent observers. It is further apparent that there was no difference between the growth of actinomycetes on stored and on freshly dug potatoes and the conclusions drawn earlier are still valid.

These observations lead to the conclusion that differences in the amount of growth of actinomycetes on different varieties of potatoes arise from causes other than the potato variety employed. This technique cannot, therefore, be used either as a test for susceptibility to scab or for the study of internal differences in the tuber.

The author takes this opportunity of expressing his sincere indebtedness to Mr. John Campbell of the Plant Pathology Department of the New Jersey Agricultural Experiment Station for supplying the potatoes used in these experiments.

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STARCH CONTENT IN POTATOES[1]

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If the activities in manufacturing by-products from farm crops are increased in the United States, there may be demands in the not distant future for potato varieties with a much higher starch content than the present commercial sorts for use in the production of starch, flour, alcohol and other commodities.

The potato breeder must either find already existing varieties to meet these demands or produce them by breeding methods. German varieties such as Parnassia, have been reported to produce from 18 to 20 per cent of starch under European conditions, percentages higher than for most of the potatoes grown in this country. Parnassia has been imported for experimental purposes, but results to date show that grown on Aroostook Farm, Presque Isle, Maine, it is inferior to Green Mountain in shape of tuber and yield, and is probably no better in the percentage of starch produced.

Ten tubers of each of these varieties grown under comparable conditions at Aroostook Farm were analyzed separately for dry matter and starch content. The tubers of Parnassia varied in percentage of dry matter from 21.4 to 25.8 with a mean of 24.2, the Green Mountain from 21.5 to 26.0 with a mean of 23.4. The Parnassia tubers varied in percentage of starch from 11.7 to 14.7 with a mean of 13.5, the Green Mountain from 9.9 to 14.5 with a mean of 12.4. The mean percentages of both dry matter and starch for Parnassia exceeded those for Green Mountain, but when the experimental variability was considered, it was found that the differences were not significant. The F for dry matter was 1.78, that for starch 3.16 with the 5 per cent level of significance for the degrees of freedom involved 4.41.

The small number of samples analyzed give only a slight indication of the relative potentials for starch production of these two varieties but it is interesting to note that greater differences were found between tubers of each variety than between the two varieties and that Parnassia, a so-called high starch producer in Europe, is probably not

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[1]Starch data supplied by H. S. Paine, Bureau of Chemistry and Soils.

[2]Senior Geneticist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry.

superior to Green Mountain in starch production when grown in Maine. This is another illustration of the behavior of a genetic character in the development of which environmental conditions must be given as much consideration as the genetic factors.

As a variety, Parnassia is quite inferior to Green Mountain and only future research will determine whether or not it is useful as a parent in the production of new varieties that will produce higher percentages of starch in the potato growing regions of the United States than the present commercial sorts.

PROGRAM

of the TWENTY-FIFTH ANNUAL MEETING of the

POTATO ASSOCIATION OF AMERICA

December 28, 1938 to December 30, 1938

President, F. A. KRANTZ, *University of Minnesota, St. Paul, Minn.*
Secretary, WM. H. MARTIN, *Rutgers University, New Brunswick, N. J.*

Wednesday Morning Session, December 28, 9:00 a. m.; Intermediate Department of the Educational Building of the Second Baptist Church.

1. Report of the Secretary-Treasurer, Editor.

2. Appointment of Committees.

3. *Potato Culture and Storage Investigations in* 1938. (10 min.) E. V. HARDENBURGH, Cornell University, Ithaca, N. Y.

4. Report of the Committee on Nomenclature. (10 min.) CHARLES F. CLARK, U. S. Department of Agriculture, Beltsville, Md.

5. *A Comparative Study of American and European Potato Virus Diseases.* (15 min.) T. P. DYKSTRA, U. S. Department of Agriculture, Beltsville, Md.

6. *Progress in Virus Disease Investigations in* 1938. (10 min.) T. P. DYKSTRA, U. S. Department of Agriculture, Beltsville, Md.

7. *Potato Production Problems in South America.* (10 min.) JOHN TUCKER, Department of Agriculture, Ottawa, Canada.

8. *A Second Report Upon Cobbler Health and Yields.* (10 min.) (Lantern) C. L. FITCH, Iowa State College of Agriculture, Ames, Iowa.

9. *Twenty-five Years in the History of the Potato.* (45 min.) F. A. KRANTZ, University of Minnesota, St. Paul, Minn.

Wednesday Afternoon Joint Session with American Society for Horticultural Science, December 28, 2:00 p. m.; Flemish Room, Jefferson Hotel.

1. *Elimination of Apical Dominance in the Potato Tuber.* (15 min.) NORWOOD C. THORNTON, Boyce Thompson Institute for Plant Research, Yonkers, N. Y.

2. *Effects of Certain Chemicals on Apical Dominance and Dormancy of Russet Burbank Potatoes.* (By Title.) GEORGE W. WOODBURY, University of Idaho, Moscow, Idaho

3. *The Effect of Length of Dormant Period of Irish Potatoes on Subsequent Yield.* (By Title) W. D. KIMBROUGH, Louisiana State University, University, La.

4. *Fertilization and Early Embryo Development in the Potato.* (15 min.) A. E. CLARKE, U. S. Department of Agriculture, Beltsville, Md.

5. *Relation of Length of Day to Flower and Seed Production in Potato Varieties.* (20 min.) A. F. CLARKE and P. M. LOMBARD, U. S. Department of Agriculture, Beltsville, Md.

6. *Foliar Diagnosis: Nutritional Differences Affecting the Yields of Potatoes from Similarly Treated Plots.* (12 min.) WALTER THOMAS and WARREN B. MACK, The Pennsylvania State College, State College, Pa.

7. *Fertilizer Requirements of the Irish Potato on Different Potato Soils of Alabama.* (10 min.) L. M. WARE, Alabama Polytechnic Institute, Auburn, Ala.

8. *Organic vs. Inorganic Nitrogen Sources in Potato and Spinach.* (10 min.) P. H. WESSELS and R. H. WHITE-STEVENS, Cornell University, Ithaca, N. Y.

9. *The Influence of Nitrogen on Grade and Shape of Triumph Sweet Potatoes in Mississippi.* (By Title) W. S. ANDERSON, Mississippi State College, State College, Miss.

10. *Relation of Minor Elements to Chemical Composition and Cooking Quality of Potatoes.* (10 min.) ORA SMITH and L. B. NASH, Cornell University, Ithaca, N. Y.

11. *Potatoes as Carriers of Vitamin C.* (10 min.) MARY E. LYONS and CARL R. FELLERS, Massachusetts State College, Amherst, Mass.

12. *Studies on Frost Prevention.* (10 min.) C. L. FITCH, Iowa State College of Agriculture, Ames, Iowa.

13. *Sun Injury to Cut Potato Seed.* (15 min.) W. C. EDMUNDSON, U. S. Department of Agriculture, Greely, Colorado.

Thursday Morning Session, December 29, 9:00 a. m.; Intermediate Department of the Educational Building of the Second Baptist Church.

1. *Potato Breeding Investigations in 1938.* (10 min.) CHARLES F. CLARK, U. S. Department of Agriculture, Beltsville, Md.

2. *Some Potato Insect Investigations in 1938.* (15 min.) G. F. MACLEOD, Cornell University, Ithaca, N. Y.

3. *Resistance in Wild Potatoes to Attack by the Potato Leafhopper (Empoasca fabae* Harris*), and the Potato Flea Beetle (Epitrix cucumeris* Harris*).* (10 min.) J. P. SLEESMAN, Ohio Agricultural Experiment Station, Wooster, Ohio.

4. *Potato Spraying in Eastern Virginia in 1938.* (10 min). (Lantern) LAUREN D. ANDERSON and HARRY G. WALKER, Virginia Truck Experiment Station, Norfolk, Va.

5. *Potato Spraying with Some Newer Copper Compounds.* (10 min.) J. H. Muncie, Michigan State College, East Lansing, Mich.

6. *Relation of the Concentration of Bordeaux Mixture to the Control of Potato Blights in Rhode Island in 1938.* (10 min.) (Lantern) FRANK L. HOWARD, Rhode Island State College, Kingston, R. I.

7. *The Rôle of Green Manures in Potato Production.* (10 min.) E. R. PURVIS, Virginia Truck Experiment Station, Norfolk, Va.

8. *Further Studies on the Placement of Fertilizer for Potatoes.* (15 min.) B. E. BROWN, H. H. ZIMMERLEY, G. V. C. HOUGHLAND, W. H. REDIT and L. G.

SCHOENLEBER, U. S. Department of Agriculture, Beltsville, Md., and Virginia Truck Experiment Station, Norfolk, Va.

9. *Developments in Potato Fertilizer Investigations in 1938.* (15 min.) ORA SMITH, Cornell University, Ithaca, N. Y.

10. *The Factors Responsible for Low Average Yields in Ohio.* (10 min.) (Lantern). JOHN BUSHNELL, Ohio Agricultural Experiment Station, Wooster, Ohio.

11. *Effects of Light and Temperature in Storage on the Growth and Yield of Potatoes.* (10 min.) E. N. MCCUBBIN, Cornell University, Ithaca, N. Y.

12. *A Preliminary Report on the Waxing of Seed Potatoes.* (5 min.) HANS PLATENIUS and E. V. HARDENBURG,, Cornell University, Ithaca, N. Y.

Thursday Afternoon Session, December 29, 2:00 p. m.; Intermediate Department of the Educational Building of the Second Baptist Church.

1. Report of Committees.

2. *Certain Aspects of the Strain Traits of Irish Potatoes in Alabama as a Requisite for Certification.* (10 min.) L. M. WARE and H. M. DARLING, Alabama Polytechnic Institute, Auburn, Ala.

3. *Potato Variety and Seedling Trials in Rhode Island.* (15 min.) (Lantern) T. E. ODLAND and T. R. COX, Rhode Island State College, Kingston, R. I.

4. *Report of the Committee on Potato Consumption and Dietetic Value.* (15 min.) C. H. METZGER, Colorado State College, Fort Collins, Colo.

5. *A Quick Method for Detecting the Possible Cooking Quality of Potatoes with Special Reference to Color.* (10 min.) J. H. MUNCIE, Michigan State College, East Lansing, Mich.

6. *Specific Gravity as an Aid in Selecting Potato Varieties with High Cooking Quality.* (15 min.) CHARLES F. CLARK, P. M. LOMBARD and ELIZABETH FULLER WHITEMAN, U. S. Department of Agriculture, Beltsville, Md.

7. *Report of the Committee for the Standardization of Cooking Tests.* E. J. WHEELER, Michigan State College, East Lansing, Mich.

8. *Symposium on Cooking Quality in Potatoes.* FLORENCE B. KING, U. S. Department of Agriculture, Washington, D. C.

Friday Morning Joint Session with American Phytopathological Society, December 30, 9:00 a. m.; Business Men's Class Room of the Second Baptist Church.

DONALD REDDICK, *Chairman*

1. *Calomel as a Soil Treatment for the Control of Potato Scab in Michigan, Long Island and New Jersey Soils.* (15 min.) (Lantern) GLENN KENKNIGHT, Michigan State College, East Lansing, Mich.

2. *The Influence of Acid and Neutral Fertilizers on the Development of Potato Scab.* (10 min.) (Lantern) HAROLD T. COOK and T. J. NUGENT, Virginia Truck Experiment Station, Norfolk, Va.

3. *The Effects of Some Agronomic Practices on Rhizoctonia Control.* (10 min.) (Lantern) F. M. BLODGETT, Cornell University, Ithaca, N. Y.

4. *pH Variations in a Soil Profile as a Possible Explanation for the Occurrence*

of Potato Scab in Acid Soils. (5 min.) R. H. DAINES and WM. H. MARTIN, N. J. Agricultural Experiment Station, New Brunswick, N. J.

5. *A Non-transmissible Spindling Sprout of Potato.* (10 min.) (Lantern) E. S. SCHULTZ, U. S. Department of Agriculture, Beltsville, Md.

6. *Further Experiments on the Cause of "Purple Top Wilt" of Potatoes.* (15 min.) J. G. LEACH, University of West Virginia, Morgantown, W. Va.

7. *A Study of the Yellow Mosaics of Potato.* (10 min.) (Lantern) T. P. DYKSTRA, U. S. Department of Agriculture, Beltsville, Md.

8. *Resistance of Potato to Latent Mosaic (Virus X).* (10 min.) F. J. STEVENSON, E. S. SCHULTZ and C. F. CLARK, U. S. Department of Agriculture, Beltsville, Md.

9. *Resistance of Potato to Mild Mosaic (Viruses A & X).* (15 min.) E. S. SCHULTZ, C. F. CLARK and F. J. STEVENSON, U. S. Department of Agriculture, Beltsville, Md.

10. *Blight Immune vs. Blight Resistant Potatoes.* (15 min.) DONALD REDDICK and W. R. MILLS, Cornell University, Ithaca, N. Y.

11. *A Reservoir of Cobbler Health.* (10 min.) (Lantern) C. L. FITCH, Iowa State College of Agriculture, Ames, Iowa.

Friday Afternoon Session, December 30, 2:00 p. m.; Intermediate Department of the Educational Building of the Second Baptist Church.

J. G. LEACH, *Chairman*

1. Round Table Discussion of New and Unusual Potato Diseases.

    1. *Bacterial Wilt Problems in Maine.* REINER BONDE, Maine Agricultural Experiment Station, Orono, Maine.

    2. *Bacterial Wilt in Canada.* H. T. GUSSOW, Department of Agriculture, Ottawa, Canada.

    3. *Identification of the Bacterial Wilt Organism.* W. H. BURKHOLDER, Cornell University, Ithaca, N. Y.

    4. *Purple Top Wilt.* J. G. LEACH, University of Minnesota, St. Paul, Minn.

    5. *Blue Stem.* C. R. ORTON, West Virginia Experiment Station, Morgantown, W. Va.

    6. *Aster Yellows on Potatoes.* F. A. HAASIS, Cornell University, Ithaca, N. Y.

    7. *Southern Bacterial Wilt.* A. H. EDDINS, Agricultural Experiment Station, Hastings, Florida.

2. Report of the Seed Potato Certification Committee. MARX KOEHNKE, Alliance, Nebraska.